

DSL Forum

Technical Report

TR-055

(Formerly WT-067v3)

ICS for ANSI T1.421 In-line Filters

February 2003

Abstract:

This Working Text defines the first set of several information flows that enable automation of the DSL service business-to-business interfaces between various business entities involved in providing DSL service. The changes reflected herein were required for consistency with WT-063 which is currently in Letter Ballot. Minor formatting and grammatical changes are also included but are not highlighted. If approved as a Technical Report, WT-074 would supercede TR-038.

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1. Revision History

Date (M/D/Y)	Version	Major Changes.
8/29/01, 9/21/01	1	Creation, First draft.
12/05/01	2	Remove Europe coverage, Correct frequency and limit errors.
03/06/02	3	Add an optional Attenuation figure of merit conformance statement. Add a new optional roll-off figure of merit statement.

2. Introduction

The ADSL Forum Testing & Interoperability Working Group has developed this T1.421 In-Line Filter ICS (Implementation Conformance Statement).

The T1.421 In-Line Filter ICS can be used for several purposes:

1. As a starting document used by an equipment vendor to document its compliance for use in an interoperability test of North American equipment.
2. As a guide for selection of the appropriate test cases to build a test suite.
3. For self-verification or certification of compliance to the T1.421 standard, when comparing to an In-Line Filter ICS filled out with the requirements of this standard.

When this proforma list is filled out and the product has passed all requirements, then usage in Customer Premise Equipment should be possible. Successful operation in a system test does not imply that the systems are [ANSI] compliant.

3. Scope

This Working Text presents an In-Line Filter ICS list targeting an [ANSI] compliant system.

Three types of ICS exist, all apply to modems and DSLAMs, but may not apply to In-Line Filters:

1. Electrical ICS,
2. Physical Layer ICS, and
3. Protocol ICS (also called PICS).

The format of the ADSL ICS is according to the guidelines specified in [ETR212]. [ETR212] also references [ISO9646].

ANNEX A contains the Conformance statement.

ANNEX B contains the electrical In-Line Filter ICS. Each ANNEX can be used as a proforma.

4. A guide to the use of the ICS proforma

4.1 Abbreviations and conventions

The ICS proforma in this document is in tabular form in accordance with the guidelines of [ETR212] and [ISO9646]. A detailed description of how to create or fill out the ICS can be found in these documents.

Item column

The item column contains a number which identifies the item in the table. The item description column describes in free text each respective item (e.g., parameters, timers). It implicitly means "is <item description> supported by the implementation?".

Status column

The following notations, defined in [ISO9646], are used for the status column:

- | | |
|-----|---|
| m | mandatory - the capability is required to be supported. |
| o | optional - the capability may be supported or not. |
| n/a | not applicable - in the given context, it is not appropriate to consider the capability. |
| x | prohibited (excluded) - there is a requirement not to use this capability in the given context. |

o.i qualified optional - for mutually exclusive or selectable options from a set. "i" is an integer which identifies an unique group of related optional items and the logic of their selection which is defined immediately following the table.

NOTE: In the case where items of the group do not always belong to the same table, all o.i shall be defined in the last sub-clause of the ICS proforma.

c.i. conditional - the requirement on the capability ("m", "o", "x" or "n/a") depends on the support of other optional or conditional items. "i" is an integer identifying an unique conditional status expression which is defined immediately following the table.

Reference column

The reference column makes references to [ANSI], except where explicitly stated otherwise.

Support column

The support column shall be filled in by the supplier of the implementation. The following common notations, defined in [ISO9646], are used for the support column:

Y or y supported by the implementation
N or n not supported by the implementation
N/A, n/a or - no answer required (allowed only if the status is n/a, directly or after evaluation of a conditional status)

Values allowed column

The values allowed column contains the type, the list, the range, or the length of values allowed. The following notations are used:

- range of values: <min value> .. <max value>
example: 5 .. 20

- list of values: <value1>, <value2>,, <valueN>
example: 2 ,4 ,6 ,8, 9
example: '1101'B, '1011'B,
example: '0A'H, '34'H, '2F'H

- list of named values: <name1>(<val1>), <name2>(<val2>),, <nameN>(<valN>)
example: reject(1), accept(2)

- length: size (<min size> .. <max size>)
example: size (1 .. 8)

- comment: one can give additional useful information an item in the form "-- <comment>".
For example in case of a list of values, a unit of measurement can be added
example: 1..63 -- dB

Values supported column

The values supported column shall be filled in by the supplier of the implementation. In this column, the values or the ranges of values supported by the implementation shall be indicated.

References to items

For each possible item answer (answer in the support column) within the ICS proforma, a unique reference exists, used, for example, in the conditional expressions.

It is defined as the table identifier, followed by a slash character "/", followed by the item number in the table. If there is more than one support column in a table, the columns are discriminated by letters (a, b, etc.), respectively.

EXAMPLE 1: A.5/4 is the reference to the answer of item 4 in table A.5.

EXAMPLE 2: A.6/3b is the reference to the second answer (*i.e.*, in the second support column) of item 3 in table A.6.

4.2 Instructions for completing the ICS proforma

The supplier of the implementation shall complete the ICS proforma in each of the spaces provided. In particular, an explicit answer shall be entered, in each of the support or supported column boxes provided, using the notation described in Section 4.1.

If necessary, the supplier may provide additional comments in space at the bottom of the tables, or separately on sheets of paper. More detailed instructions are given at the beginning of the different sub-clauses of the ICS proforma.

Roles: the supplier should only fill in the items depending on the role of his implementation. For example, The ATU-R vendor should fill out the tables marked ATU-R. The ATU-C vendor should fill out the tables marked ATU-C. When a table contains both roles, then only the appropriate role should be filled out.

4.3 Examples

Following is an example of an optional item. The answer can be ‘yes’ or ‘no’. Both are allowed and compliant.

Table X.1: ATU-C send C-tone

Item	Signal	Reference	Status	Support
1	C-tone	9.2.1.3	o	Y

Following is an example of a mandatory item. The answer can be ‘yes’ or ‘no’. The answer must be ‘yes’ to be compliant.

Table X.2: ATU-R receive C-Tone

Item	Signal	Reference	Status	Support
1	C-tone	9.2.1.3	m	y

Following is an example of a mandatory item including a range of values. The answer can be ‘yes’ or ‘no’. The answer must be ‘yes’ to be compliant. Supported values must be the complete range or a subset of the range to be compliant.

In the case of table X.3 the full range is needed to be compliant.

In the case of table X.4 a subset of the range is sufficient to be compliant.

Refer to the indicated reference to determine if the full range or subset is required.

Table X.3: ATU-C detection & response to R-ACT-REQ

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	R-ACT-REQ	9.2.1.1	m	y	-32..48	-32..48

Table X.4: ATU-C C-SEGUE used tones

Item	Signal	Reference	Status	Support	Values	
					Allowed	Supported
1	C-SEGUE1	9.6.1	m	y	5..255	48.255
2	C-SEGUE2	9.8.2	m	y	5..255	48.255

Following is an example of a qualified optional item. The qualifier is mentioned below the table.

Table X.5: ATU-R response to C-ACTx

Item	Signal	Reference	Status	Support
1	R-ACK1	9.3.3	o.2	n
2	R-ACK2	9.3.3	o.2	y
3	R-ACK3	9.3.3	n/a	-

o.2 : the ATU-R shall transmit only one of these signals

Following is an example of a conditional item. The answer depends on the response to the question put under the table. For example, IF in table A.23 item 2 OR in table A.23 item 3 have been answered 'yes' then this item is mandatory, ELSE it is prohibited.

Table X.6: Downstream sub-channel support

Item	Sub-channel	Reference	Status	Support	
				<i>ATU-C</i>	<i>ATU-R</i>
1	AS0	5.2	m	<i>y</i>	<i>y</i>
2	AS1	5.2	c2401	<i>n</i>	<i>n</i>

c2401: IF /2 OR /3 THEN m ELSE x

5. References

- [ANSI] ANSI T1.421-2001, In-Line Filter for Use with Voiceband Terminal Equipment Operating on the Same Wire Pair with High Frequency (up to 12 MHz) Devices
- [ETR212] ETSI TC-MTS: Methods for testing and Specification (MTS). Implementation Conformance Statement proforma style guide. ETR 212 December 1995 (DTR/MTS-00004)
- [ISO9646] ISO/IEC 9646-1 (1994): Information technology - open systems interconnection - conformance testing methodology and framework- Part 1: General Concepts

ANNEX A: Conformance Statement

A.1 Identification of the implementation

Identification of the Implementation Under Test (IUT) and the system in which it resides (the System Under Test - SUT) should be filled out so as to provide as much detail as possible regarding version numbers and configuration options.

The product supplier information and client information should both be filled in if they are different.

A person who can answer queries regarding information supplied in the ICS should be named as the contact person.

A.2 Date of the statement

.....

A.3 Implementation Under Test (IUT) identification

IUT name:

.....

.....

IUT version:

.....

A.4 System Under Test (SUT) identification

SUT name:

.....

Hardware configuration:

.....

.....

.....

Operating system/SW version:

.....

A.5 Product supplier Name

.....

Address:

.....
.....
.....

Telephone number:

.....

Facsimile number:

.....

E-mail address:

.....

Additional information:

.....
.....
.....

A.6 Client (if different from product supplier) Name

.....

Address:

.....
.....
.....

Telephone number:

.....

Facsimile number:

.....

E-mail address:

.....

A.7 Identification of the reference standard

This ICS proforma applies to the following standard:

[ANSI] T1.421-2001 -- ATM based implementation

A.8 Global statement of conformance

Are all mandatory capabilities implemented ? (Yes/No)

NOTE: Answering "No" to this question indicates non-conformance to the [ANSI] specification. Non-supported mandatory capabilities are to be identified in the ICS, with an explanation of why the implementation is non-conforming, on pages attached to the ICS proforma.

ANNEX B: Electrical In-Line Filter ICS

B.1 CPE In-Line Filter DC and Voice Band Characteristics

Customer Premise Equipment (CPE) ANSI T1.421 (T1E1.4/2001-007R3) In-Line Filter

B.1.1 CPE In-Line Filter DC Characteristics

The table below shows the DC resistance requirements of the CPE In-Line Filter.

Table B.1: CPE In-Line Filter DC Resistance

Item	Test label	Reference	Status	Support	Values	
					Allowed	Supported
		ANSI T1.421			Allowed	Supported
1	Tip to Ring DC Resistance at 20 mA current.	4.1	M		$\leq 25 \text{ } \Omega$	
2	Tip to Ring DC Resistance at 7, 10 and 90 mA.	4.1	M		+/-10% of item 1	
3	Tip, Ring to Ground DCR with ≤ 100 volts.	4.1	M		$> 10 \text{ } M\Omega$	
4	Tip, Ring to Ground DCR between 100 to 200 volts.	4.1	M		$> 30 \text{ } k\Omega$	

B.1.2 CPE In-Line Filter Voice Band Insertion Loss

The tables below shows the source to termination insertion loss requirements. Measurements are made at 1004 Hz with and without the CPE In-Line Filter/ZHP combination inserted. The allowed values are the maximum insertion loss permitted due to the addition of the CPE In-Line Filter(s)/ZHP. Limits apply with single and up to five filters. Results for one, three and five filters are to be recorded in the table. Note: Insertion loss is a positive value and gain is a negative value.

Table B.2: CPE In-Line Filter On-hook Voice Band Insertion Loss

Item	Test label	Reference	Status	Support	Values	
					Allowed	Supported
		ANSI T1.421			Allowed	Supported
1	Single Filter	5.1	M		+1.5 .. -0.5 dB	
2	Three Filters	5.1	M		+6.5 .. -1.0 dB	
3	Five Filters	5.1	M		+6.5 .. -1.0 dB	

Table B.3: CPE In-Line Filter Off-hook Voice Band Insertion Loss

Item	Test label	Reference	Status	Support	Values	
					Allowed	Supported
		ANSI T1.421			Allowed	Supported
1	Single Filter	6.1	M		+0.5 .. -0.5 --dB	
2	Three Filters	6.1	M		+1.0 .. -1.0 dB	
3	Five Filters	6.1	M		+1.0 .. -1.0 --dB	

B.1.3 CPE In-Line Filter Voice Band Insertion Loss Distortion

The tables below shows the maximum permissible variation of insertion loss with frequency as compared to the 1004 Hz measurement with the CPE In Line Filter(s)/ZHP. Limits apply with single and up to five filters. Results for one, three and five filters are to be recorded in the table. Note: Insertion loss is a positive value, gain is negative.

Table B.4: CPE In-Line Filter On-hook Voice Band Insertion Loss Distortion

Item	Test label	Reference	Status	Support	Values	
					Allowed	Supported
		ANSI T1.421				
1	Single Filter: 0.2 to 1.0 kHz	5.2	M		+1.5 .. -1.5 --dB	
2	Single Filter: 1.0 to 2.8 kHz	5.2	M		+1.5 .. -1.5 --dB	
3	Three Filters: 0.2 to 1.0 kHz	5.2	M		+2.0.. -5.5 --dB	
4	Three Filters: 1.0 to 2.8 kHz	5.2	M		+2.0.. - 2.0 --dB	
5	Five Filters: 0.2 to 1.0 kHz	5.2	M		+2.0.. -5.5 --dB	
6	Five Filters: 1.0 to 2.8 kHz	5.2	M		+2.0 .. -2.0 --dB	

Table B.5: CPE In-Line Filter Off-hook Voice Band Insertion Loss Distortion

Item	Test label	Reference	Status	Support	Values	
					Allowed	Supported
		ANSI T1.421				
1	Single Filter: 0.2 to 3.4 kHz	6.2	M		+0.5 .. -1.0 --dB	
2	Single Filter: 3.4 to 4.0 kHz	6.2	M		+1.0 .. -1.5 --dB	
3	Three Filters: 0.2 to 3.4 kHz	6.2	M		+2.5.. -1.5 --dB	
4	Three Filters: 3.4 to 4.0 kHz	6.2	M		+3.25..-2.0 --dB	
5	Five Filters: 0.2 to 3.4 kHz	6.2	M		+2.5.. -1.5 --dB	
6	Five Filters: 3.4 to 4.0 kHz	6.2	M		+3.25 .. -2.0 --dB	

B.1.4 CPE In-Line Filter Voice Band Insertion Envelope Delay Distortion

The tables below shows the maximum permissible variation of envelope delay distortion by the addition of the CPE In-Line Filter(s). Limits apply with single or up to five filters. Results for one, three and five filters are to be recorded in the table.

Table B.6: CPE In-Line Filter On-hook Voice Band Insertion Envelope Delay Distortion

Item	Test label	Reference	Status	Support	Values			
					Allowed	Supported		
						Number of Filters		
1	Single or Multiple Filters (Five Max): 0.3 to 2.8 kHz	ANSI T1.421	M		1	3	5	
		5.3	M		<= 250 uSec			

Table B.7: CPE In-Line Filter Off-hook Voice Band Insertion Envelope Delay Distortion

Item	Test label	Reference	Status	Support	Values			
					Allowed	Supported		
						Number of Filters		
1	Single or Multiple Filters (Five Max): 0.3 to 3.4 kHz	ANSI T1.421	M		1	3	5	
		6.5	M		<= 250 uSec			

B.1.5 CPE In-Line Filter Impedance Distortion

The table below shows the permissible values of return loss for the CPE In-Line filter(s) under the conditions specified in the reference. Limits apply to single filter or up to five filters. Results are to be recorded in the table for one, three and five filters.

Table B.8: CPE In-Line Filter Off-hook Impedance Distortion

Item	Test label	Reference	Status	Support	Values			
					Allowed	Supported		
						Number of Filters		
1	Phone port SRL-L	ANSI T1.421	M		1	3	5	
2	Phone port ERL	6.3	M		>13dB			
3	Phone port SRL-H	6.3	M		> 9dB			
4	Network port SRL-L	6.3	M		> 3dB			
5	Network port ERL	6.3	M		> 12dB			
6	Network port SRL-H	6.3	M		> 10dB			
		6.3	M		> 5dB			

B.1.6 CPE In-Line Filter Off-hook Voice Band Inter-modulation Distortion

The table below shows the maximum permissible total harmonic distortion contributed by the addition of the In-Line filter(s). Limits apply with single and up to five filters. Results for one, three and five filters are to be recorded in the table.

Table B.9: CPE In-Line Filter Off-hook Voice Band Inter-modulation Distortion

Item	Test label	Reference	Status	Support	Allowed	Values		
						Supported		
						Number of Filters		
					1	3	5	
1	Second Order Distortion Product	6.4	M		>= 57 --dB			
2	Third Order Distortion Product	6.4	M		>= 60 --dB			

B.1.7 CPE In-Line Filter Transverse Balance

The table below gives the transverse balance requirements of the In-Line Filter(s). Limits apply with single and up to five filters. Results for one, three and five filters are to be recorded in the table.

Table B.10: CPE In-Line Filter Transverse Balance

Item	Test label	Reference	Status	Support	Allowed	Values		
						Supported		
						Number of Filters		
					1	3	5	
1	Off-hook Balance: .2-1kHz	7	M		> 40 dB			
2	Off-hook Balance: 1-12kHz	7	M		> 40 dB			
3	Off-hook Balance: 12kHz-1.544MHz	7	M		> 35 dB			
4	Off-hook Balance: 1.544MHz-12MHz	7	M		> 30 dB			
5	On-hook Balance: .2-1kHz	7	M		> 60 dB			
6	On-hook Balance: 1-12kHz	7	M		> 40 dB			
7	On-hook Balance: 12kHz-1.544MHz	7	M		> 35 dB			
8	On-hook Balance: 1.544MHz-12MHz	7	M		> 30 dB			

B.2 CPE In-Line Filter High Frequency Band (HB) Characteristics

B.2.1 CPE In-Line Filter HB Stopband Attenuation

The tables below shows the permissible High Frequency Band (HB) attenuation contributed by the addition of the CPE In-Line Filter(s). Limits apply with single and up to five filters. Results for one, three and five filters are to be recorded in the table.

Table B.11: CPE In-Line Filter On-hook HB Stopband Attenuation

Item	Test label	Reference	Status	Support	Allowed	Values		
						Supported		
						Number of Filters		
					1	3	5	
1	Attenuation: 25 to 50 kHz	8.1	M		> 12 --dB			
2	Attenuation: 50 kHz to 12 MHz	8.1	M		> 12 --dB			

Table B.12: CPE In-Line Filter Off-hook HB Stopband Attenuation

Item	Test label	Reference	Status	Support	Values			
					Allowed	Supported		
						Number of Filters		
1	3	5						
1	Attenuation: 25 to 50 kHz with 20 and 90 mA	8.2	M		> 21 –dB			
2	Attenuation: 50 kHz to 12 MHz with 20 and 90 mA	8.2	M		> 25 –dB			
3	Attenuation: 25 to 50 kHz with 7 mA	8.2	M		> 13 –dB			
4	Attenuation: 50 kHz to 12 MHz with 7 mA	8.2	M		> 22 –dB			
5	Stopband Attenuation Figure of Merit	<i>See Annex C</i>	O		> 0 –dB			
6	Roll-off Figure of Merit	<i>See Annex C</i>	O		> 12 dB/octave			

B.2.2 CPE In-Line Filter HB Bridging Loss

The table below shows the permissible loading of the HB path contributed by the addition of the CPE In-Line Filter(s). Limits apply with single and up to five filters. Results for one, three and five filters are to be recorded in the table. Note: Loss is a positive value and gain is a negative value.

Table B.13: CPE In-Line Filter Off-hook HB Bridging Loss

Item	Test label	Reference	Status	Support	Values	
					Allowed	Supported
1	One Filter: 25 kHz to 1.2 MHz	8.3	M		<= 0.5 --dB	
2	One Filter: 1.2 MHz to 12 MHz	8.3	M		<= 3.0 --dB	
3	Three Filters: 25 kHz to 1.2 MHz	8.3	M		<= 1.25 –dB	
4	Three Filters: 1.2 MHz to 12 MHz	8.3	M		<= 4.0 --dB	
5	Five Filters: 25 kHz to 1.2 MHz	8.3	M		<= 1.25 –dB	
6	Five Filters: 1.2 MHz to 12 MHz	8.3	M		<= 4.0 --dB	

B.2.3 CPE In-Line Filter ADSL Band Inter-modulation Distortion

The table below shows the maximum permissible total harmonic distortion contributed by the addition of the In-Line filter(s). Limits apply with single and up to five filters. Results for one, three and five filters are to be recorded in the table.

Table B.14: CPE In-Line Filter ADSL Band Inter-modulation Distortion

Item	Test label	Reference	Status	Support	Values			
					Allowed	Supported		
						Number of Filters		
1	3	5						
1	Upstream on-hook distortion component 200 to 400 kHz	8.4.1	M		<= -140 dBm/Hz			
2	Upstream off-hook distortion component 200 to 400 kHz	8.4.2	M		<= -130 dBm/Hz			
3	Downstream on and off-hook distortion component 25 to 100 kHz	8.4.3	M		<= -114 dBm/Hz			

ANNEX C – Figure Of Merit (informative)

Informative Annex C describes an optional Figures of Merit (FOM) that extends performance to address broader applications, longer reach, higher data rates, and improved POTS service quality. The purpose of the FOM is to enable the In-Line filter standard to better address the needs of technologies that cover the entire non-loaded resistance design service area. The Figures of Merit address increased DSL stopband attenuation.

C.1 Stopband Attenuation and Roll-Off Figures of Merit

Increased stopband attenuation permits higher xDSL signal levels on the line without degradation of POTS audio quality caused by xDSL signals at the voiceband device. Similarly, increased stopband attenuation improves POTS audio quality for a given xDSL signal level.

As a result, increased stopband attenuation can provide:

- Longer xDSL service reach and area coverage at a given data rate without degraded POTS audio quality.
- Higher xDSL data rates within a given service area without degraded voice-grade audio quality.
- Higher POTS audio quality on a larger percentage of voiceband devices within a given service area and service data rate.

In-Line filters complying with this specification can optionally be identified as having a:

1. "Stopband Attenuation Figure of Merit = A dB"

Where A is the additional attenuation above the requirements defined in Clause 8.2, that is, the stopband attenuation is at least (21 + A) dB from 25 kHz to 50 kHz and at least (25 +A) dB from 50 kHz to 12 MHz.

or having a (not yet implemented in T1.421):

2. "Roll-Off Figure of Merit = B dB/octave"

Where B is roll-off attenuation of the filter expressed in dB/octave above 25 kHz. The recommendation is to reach at least B = 12 dB/octave.